

Physico-chemical Analysis of Ground Water Quality of Chaibasa, Jharkhand with Special Reference to Nitrate

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ABSTRACT

The Area under study, Chaibasa is situated in the West Singhbhum of Jharkhand State. The present study deals with physico-chemical parameter of ground water with special reference to Nitrate of five different areas of Chaibasa town and its adjoining area *i.e.* Khaparsai (S₁), Meritola (S₂), Kumhartoli (S₃), Supalsai (S₄) and Madhulab (S₅). The groundwater parameters such as temperature, pH, turbidity, electrical conductivity, alkalinity, dissolved oxygen, biochemical oxygen demand, total hardness, calcium, magnesium, phosphate, sulphate, nitrate, iron, chloride and fluoride were estimated in the samples to evaluate their quality. The data of physico chemical parameters are compared with WHO (1992) and IS: 10500 standards for drinking water. Our result revealed that concentration of DO, BOD, Total hardness, Calcium, magnesium, sulphate, turbidity, alkalinity, phosphate, iron and chloride are within permissible limits and Iron, phosphate are negligible in comparison to permissible limits whereas the concentration of Nitrate is higher at sampling areas S₂, S₃ and S₅. The concentration of Nitrate varied from 20 to 60 mg/l and the permissible limit is 45 mg/l as per suggested by WHO and ISI. The higher concentration of Nitrate needs proper treatment before the use for drinking purposes and irrigation purposes. Finally it can be suggested that an intensive study may be carried out before the domestic consumption.

Keywords: Groundwater, Physico-chemical parameter, Water quality, Dissolved oxygen.

INTRODUCTION

Water is one of the most important and basic natural resources and forms about 75% of the matter of the earth crust and present in the form of marine water (Ocean and Sea) and fresh water (River, Lake, ponds, Streams and Ground water etc.).

Water is the prime requirement for life and used for drinking, bathing, recreation, irrigation, fisheries, navigation and power generation purposes etc. India receives 1800-1900 mm of rainfall annually. According to an estimate made by Indian central water commission (ICWC) for pollution control the total utilizable water from surface water sources is 690 cubic kms and ground water sources is about 452 cubic kms (Sud., 1997).

The management for waste water discharges from habitat centers, industries, agricultural activities etc to maintain the quality for various purposes.

India required 60% water for irrigation and 85% for drinking purposes which depends upon groundwater ; India is the largest user of ground water in using over 25% of the total global use of ground water. (Gautam and Kumar, 2010) India has more than 20 million bore wells in comparison to 0.2 million in USA.

The increasing human population has tremendously increased the demand of fresh water. The rapid growth of urban areas has affected the ground water quality due to over exploitation of resources and improper waste disposal practices. National Environmental Engineering Research Institute (NEERI), Nagpur has estimated that

a staggering 70 % of the available water in India is polluted (Sharma *et al.*, 1996-1997).

Due to heavy mining activities in and around the district of west singhbhum, the quality of ground water may deteriorate further in future and no detailed investigation on ground water quality of this region has been carried out. Hence in the present study and investigation has been designed to understand the chemical characteristics of ground water of this region with special reference to nitrate.

AIM AND OBJECTIVE

The objective of the present investigation has been made to understand the chemical characteristics of ground water quality of Chaibasa with special reference to nitrate.

STUDY AREA

Chaibasa is located in the West Singhbhum district of Jharkhand located at 22°-25° 15' N Latitude and 83°-87° E Longitude. It is at a height of about 243.73 metre above the mean sea level. The average rainfall is about 1168 mm. The major rainfalls occur by south-west monsoon. Summer temperature shoots up to 44°C in the month of June and Winter falls down up to 7°C . The average relative humidity is about 56%.

In the present investigation, there are five water samples from different areas of Chaibasa were collected in the month of October 2011 to estimate quality of Ground water. These water were extensively used

for drinking purposes. The sampling stations are, Kharsai (S1), Meri Tola (S2), Kumhar Toli (S3) Supalsai (S4) and Madhu Talab (S5).

MATERIALS AND METHODS

The analysis of Phosphate, Iron, P^H , Total Alkalinity, Calcium Hardness, Nitrate,

Nitrite, Ammonium, Fluoride, Residual-chlorine, chloride, Arsenic etc. were carried out by water testing kits which are supplied by Nice Chemicals (P)Ltd. Cochin, Kerala. The temperature of water samples were measured by thermometer (Celsius). The water analysis observed data were compared with the standard data provided by WHO for drinking purposes.

Table 1 : Showing different Physico-Chemical Parameters of Ground Water of Chaibasa.

Sl.No.	Parameters	STUDY AREA LOCATION				
		S1	S2	S3	S4	S5
1.	Temperature($^{\circ}C$)	28	28	28	27	27
2.	P^H	8	8	9	8	9
3.	Alkalinity (mg/l)	240	250	300	150	300
4.	Phosphate (mg/l)	0.0	0.0	0.0	0.0	0.0
5.	Iron (mg/l)	0.2	0.3	3.0	0.3	0.3
6.	Calcium Hardness (mg/l)	225	300	400	100	300
7.	Nitrate (mg/l)	20	50	60	30	50
8.	Nitrite (mg/l)	0.0	3.0	3.0	0.5	1.0
9.	Ammonium (mg/l)	0.5	1.0	1.0	3.0	0.5
10.	Fluoride (mg/l)	0.0	0.0	0.0	0.0	0.0
11.	Residual chlorine (mg/l)	0.0	0.0	0.0	0.0	0.0
12.	Chloride (mg/l)	300	320	670	150	220
13.	Arsenic (mg/l)	0.0	0.0	0.0	0.0	0.0
14.	Total Hardness (mg/l)	350	600	800	150	500
15.	Sulphate (mg/l)	150	120	130	140	170
16.	Sodium (mg/l)	55	60	45	35	60
17.	Potassium (mg/l)	6	8	10	7	11
18.	DO (mg/l)	3.2	2.3	4.0	3.5	2.1
19.	BOD (mg/l)	2.0	1.5	2.2	2.8	2.4

RESULTS AND DISCUSSION

The Physico-chemical characteristics of ground water are given in Table-1. and data are comparing with WHO (1992) and IS: 10500 standards for drinking water.

Temperature: Temperature of water plays important role for living beings. Quality of

water is also maintained by temperature. The temperature of different sampling station ranges from $27^{\circ}C$ to $28^{\circ}C$

pH: The pH of ground water ranges from 8 to 9 which is within the range of drinking water proposed by ISI 1991 is 6.5 to 8.5.

Alkalinity: Generally ground water associated with dissolved carbon dioxide,

bicarbonates and hydroxides which occurs due to dissolution of minerals in the soil. The values of alkalinity ranges from 150 to 300 mg/l.

Iron: The concentration of iron varies from 0.2mg/L to 3.0 mg/L whereas permissible limit for iron is 0.3 to 1.0 mg/L. Only the sample S3 have higher value of iron (3mg/l).

Calcium Hardness: The value of calcium hardness varies from 100mg/l to 400mg/l.

Nitrate: The biochemical oxidations of nitrogenous substances coming from domestic wastes are main source of nitrate in Ground Water. The concentration of nitrate in present study varies from 20 mg/l to 60 mg/L which is higher the permissible limit of WHO health based guide line values. The concentrations of nitrate above 40mg/L cause Blue diseases in infants (Sharma, 1997).

Nitrite: It varies from 0.0 to 3.0 mg/l in the samples.

Ammonium: It varies from 0.5 to 3.0 mg/l
Chloride : The chloride values ranges from 150 mg/L to 670 mg/L in the present sample. The permissible limit of chloride in drinking water is 250mg/L as suggested by WHO and ISI. The higher concentration of chloride may affect heart and kidney disease affected person (Patil *et al.*, 2002)

Total Hardness: The temporary hardness of water is only due to dissolved of Calcium and Magnesium bicarbonate in water, whereas permanent hardness is due to presence of chlorides of Calcium and Magnesium in water. The value of total hardness ranges

150 to 1500mg/L. However, there is no firm evidence suggesting drinking of hard water cause any adverse effect on health (Doctor *et al.*, 1998)

The observed values of sulphate, sodium, potassium, DO, BOD are within the permissible limits as per WHO guide lines for drinking water.

The values of phosphate, fluoride, residual chlorine and arsenic are observed negligible.

Table-2: Drinking water specification as per Is:10500-1993 revised

S. No	Parameters	Desirable Limit	Permissible Limit in the absence of Alterane
		6.5 to 8.5	No Relaxation
3.	Total Hardness as CaCO ₃ (mg/L)	300	600
4.	Iron (mg/L)	0.3	1.0
5.	Chloride (mg/L)	250	1000
6.	Fluoride (mg/L)	1.0	1.5
7.	T.D.S (mg/L)	500	2000
8.	Calcium (mg/L)	75	200
9.	Magnesium (mg/L)	30	100
10.	Nitrate (mg/L)	45	100
11.	Sulphate (mg/L)	200	400
11.	Sulphate (mg/L)	200	400
12.	Alkalinity (mg/L)	200	600
13.*	Sodium (mg/L)	75	-
14.*	Potassium (mg/L)	12	-

*As per WHO Guideline.

CONCLUSION

It was observed that the concentration of nitrate are much higher than the permissible limit i.e., 45mg/l as

suggested by WHO for drinking water. The higher concentration of nitrate needs proper treatment before the use for drinking purposes.

SUGGESTION

The detail investigation may be carried out on other living organisms to avoid the hazardous/ injurious impact of the nitrate contamination.

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